Programs at a Glance

Programs-at-a-Glance

In FY2004 the MEL Management Council worked to ensure the future vitality, quality, and productivity of the laboratory's portfolio of technical programs. The MEL Management Council assessed the technical direction and goals, the structure, and the operation of the entire MEL technical program portfolio and made changes as warranted by that assessment. The result is a refreshed portfolio that addresses the needs of our customers, is aligned with NIST strategic directions, makes maximum use of our technical capability, and is managed effectively and efficiently.

This section is designed to give you a quick overview of MEL's eight technical programs. It contains one-page, high-level descriptions for each programs. These descriptions include contact information for the program manager, the program goal, a problem statement, technical approach, and a listing of typical customers and collaborators. A detailed description of each program can be found later in this book and on our website at www.mel.nist.gov/proj.

Dimensional Metrology

Program Manager:	Steven D. Phillips
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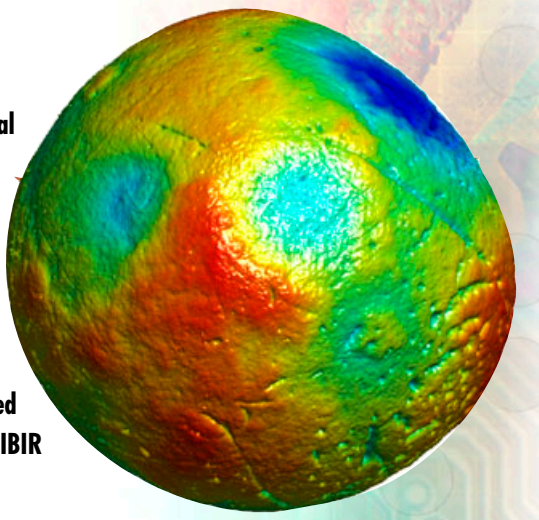
Program Funding:	$4 M
FTEs	19

Program Goal

Develop and deliver timely dimensional measurements and standards to address critical U.S. industry needs for traceable dimensional metrology, particularly for the support of trade and innovation, process control, and quality in manufacturing from the micro- to the macro-scale.

Problem

Dimensional metrology spans a vast array of products and industries, from large scale manufacturing of ships and aircraft, to miniaturized mechanical components, to precision optics. The globalization of manufacturing has resulted in complex products with components produced all over the world that must assemble and function seamlessly. Accurate dimensional metrology is essential to meeting this goal. New manufacturing technology is entering industry continuously and often has little or no supporting metrology. NIST, positioned at the top of the traceability pyramid, is challenged to support this broad network of industrial and laboratory dimensional measurements.



Three dimensional representation of the form error of a 100 mm diameter silicon sphere measured by XCALIBIR

Approach

The dimensional metrology program seeks to realize and disseminate the SI (Système International d'unités) unit of length across a wide range of calibration services and artifacts, and to support industrial dimensional metrology through national and international measurement standards. The program funds calibration services and standard reference materials, along with their associated quality assurance programs. The program also identifies and supports research and development (R&D) for new and emerging measurement needs including: (1) precision optics with emphasis on aspheric and free form optics; (2) 3D coordinate measurement of miniaturized features; and, (3) complex 3D surfaces including large scale optical metrology, scanning probe evaluations, and data fitting.

Typical Customers and Collaborators

Department of Defense (DOD), Department of Energy, aerospace industry, automotive industry, heavy equipment and machinery industry, state weights and measures labs, and metrology instrumentation manufacturers.

For more information see page 31

Homeland and Industrial Control Security

Program Manager:	Al Wavering
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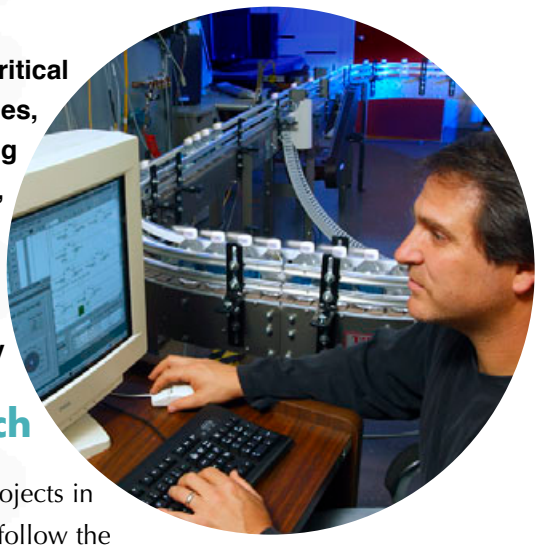
Program Funding:	$3.5 M
FTEs:	8.8

Program Goal

Develop and apply MEL capabilities, tools, and methods to enhance: Preparation for, prevention of, defense against, and response to threats and aggressions against the domestic population and infrastructure of the United States; and Effectiveness of domestic emergency response and law.

Problem

The Department of Homeland Security (DHS) and federal, state, and local emergency response agencies and personnel need an integrated infrastructure of performance metrics, test methods and standards to 1) enable specification, evaluation, and integration of homeland security and public safety equipment and systems, and 2) encourage investment in homeland security science and technology efforts. The lack of consensus in national requirements and standards slows development and leads to confusion among both suppliers and users of homeland security technologies. In coordination with related efforts internal and external to NIST, the MEL Homeland and Industrial Control Security (H&ICS) Program helps build this standards infrastructure, primarily in areas that cut across multiple vulnerability, threat, and response mode categories.



Securing critical industries, including water, electrical power, and chemical is a top priority

Approach

In general, projects in this program follow the approach used for all DHS standards development and implementation projects. For each component or system under consideration, guidelines will be developed as a collaborative effort among tool developers, users/subject matter experts, and standards experts. Requirements and guidelines will be defined using information related to the capabilities – and the limitations - of the components, and on the conditions in which the component and system are expected to operate. The guidelines will be the foundation for constructing performance measures and testing and evaluation protocols that will provide a reproducible method for assessing and comparing the effectiveness of each system component and of the systems supporting homeland security. Performance measures will encompass: basic functionality, adequacy and appropriateness for the task, interoperability, efficiency, and sustainability.

Typical Customers and Collaborators

Department of Homeland Security Science & Technology and Emergency Preparedness and Response Directorates, National Institute of Justice, ISA: the Society for Instrumentation, Systems, and Automation, Institute of Electrical and Electronics Engineers (IEEE), Critical Infrastructure owner-operators and suppliers, and the Department of Defense.

For more information see page 44

Intelligent Control of Mobility Systems

Program Manager:	Maris Juberts
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Program Funding:	$4.1 M
FTEs:	13.5

Program Goal

Provide architectures and interface standards, performance test methods and data, and infrastructure technology needed by U.S. manufacturing industry and government agencies in developing and applying intelligent control technology to mobility systems to reduce operational costs, improve performance and safety, and save lives.

Problem

As mobile systems become more intelligent, their use in the field increases. Material handling systems could be used for loading and unloading of trucks, autonomous vehicles can provide an unmanned ground force for the Army, and on-vehicle crash avoidance systems may become more effective. However, to develop and use intelligent mobile systems, industry and government agencies need architectures and interface standards to insure interoperability, real-time sensing technologies for measurement and control, and metrics for evaluating the performance of components and systems

Approach

This program will provide industry with standards, performance metrics, and infrastructure technology to broaden the use of advanced perception and autonomous navigation techniques; provide defense agencies with the control system architectures, advanced sensor systems, research services and standards to achieve efficient use of unmanned ground vehicles in the battlefield; provide the evaluation and measurement methods, testing procedures, standard reference data needed to support the deployment of advanced technology in transportation and industrial safety systems. The program will use the NIST-developed reference model architecture for intelligent unmanned ground vehicle - 4D/RCS - architecture as an example of an open system architecture for building complex autonomous robotic systems for other government agency programs. Relevant advanced robotics technology will be transferred to industrial applications.

Typical Customers and Collaborators

- Army Research Lab
- Applanix
- Robotics Technology Inc.
- University of Maryland
- DARPA
- National Highway Traffic Safety Administration (NHTSA)
- The Boeing Company
- Transbotics
- Drexel University
- Visteon & Assistware
- Bremen Univ./Germany
- DOT
- ATR
- TACOM/TARDEC
- EarthData Inc.
- University of Delaware
- OSD/JRP
- General Dynamics Robotic Systems

For more information see page 54

Manufacturing Interoperability

Program Manager:	Steven Ray
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Program Funding:	$3.9 M
FTEs:	26

Program Goal

Equip U.S. manufacturers with the technical guidance and testing support needed to interoperate in today's global, heterogeneous manufacturing world.

Problem

Globalization is the major trend in manufacturing today — globalization of markets and globalization of partners. Both have led to an explosion in the amount of information sharing that must take place. Nevertheless, humans still provide the bulk of the understanding needed to determine what the information means and the majority of the tacit knowledge needed to make decisions based on that understanding. It is absolutely critical to the success of companies and their suppliers that this sharing is done correctly, efficiently, and inexpensively. Changes in technology are positively impacting the way in which this information sharing takes place.

Approach

We work with industrial partners to overcome the barriers that arise from the increased reliance on electronic information exchange, using a virtual manufacturing environment where vendors and manufacturers can test conformance to existing standards; and researchers can validate the next generation of standards

incorporating semantic web technologies. This program focuses on three major thrusts: an interoperability testing and demonstration infrastructure; testing of key integration standards for today's manufacturers; and developing semantic technologies for tomorrow's integration needs.

Typical Customers and Collaborators

Industry:

Accordare, Drake Certivo, Lockheed Martin, Nyamekye Research and Consulting Firm, Covisint, General Motors (GM), Ford, Lear, Lesker Corporation, The Boeing Company, Deere & Company, LK Metrology, Mitutoyo, Pratt & Whitney, DaimlerChrysler, GE, LK, Zeis, Nihon Unisys

Consortium:

Automotive Industry Action Group (AIAG), PDES, Inc., Metrology Automation Association (MAA)

Software Vendor:

AutoSimulation, Inc., EDS, Promodel Corporation, Micro Analysis & Design Incorporated, Softimage, Proplanner, Flexsim Software, Emergis, Fujitsu, QAD, SAP, Sterling Commerce, iConnect, Wolverine Software, Simul8 Corp., Delmia Corporation, Rockwell Software, Sewickley, Knowledge Based Systems, Inc., Technomatix, Delmia, Wilcox, Theorem Solutions

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Manufacturing Metrology and Standards for the Health Care Enterprise

Program Manager:	Ram D. Sriram
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Program Funding:	$595K
FTEs:	2.4

Program Goal

Apply proven MEL manufacturing technology and expertise to healthcare systems, biomedical devices and equipment, and biomedical data management.

Problem

Spending on healthcare in the United States was about 13.2% of the Gross Domestic Product (GDP) in 2000 and continues to grow at the rate of 7.3% per year. Typically U.S. employers offer health insurance benefits to their staff and retirees, making the issue of escalating healthcare costs a major concern. As these costs increase, they raise the cost of doing business and impede our ability to compete globally.

Healthcare and manufacturing share many similar organizational and informational issues. Thus, the healthcare industry as a whole is a customer for the metrology, standard-setting support and technology approaches and solutions that MEL has developed for the manufacturing sector. The healthcare industry needs an infrastructure that will accelerate and enrich development of methodologies to improve organizational and informational support for all aspects of health care delivery.

Approach

There are two dimensions to the program: (1) Healthcare informatics; and (2) Medical devices. Healthcare informatics deals with all the processes or "software" of the healthcare enterprise. Medical devices deal with all the products or "hardware" of the enterprise. The program deals with the following objectives within the above two dimensions:

Healthcare informatics

Enterprise modeling and simulation, Design and production of pharmaceuticals, Biosurveillance, Manufacturing and value chain management

Clinical informatics

Bioinformatics, Medical devices, Mobility devices, Hearing devices, Intelligent assistive surgical devices (medical robots), Surface characterization of biomedical devices, Meso-micro-biodevices, Nano-biodevices

Typical Customers and Collaborators

Healthcare providers and organizations; Process modeling vendors; Healthcare informatics vendors and consultants; Medical device industry; Academic institutions; Government organizations; Various associations and standard bodies.

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Mechanical Metrology

Program Manager:	Zeina J. Jabbour
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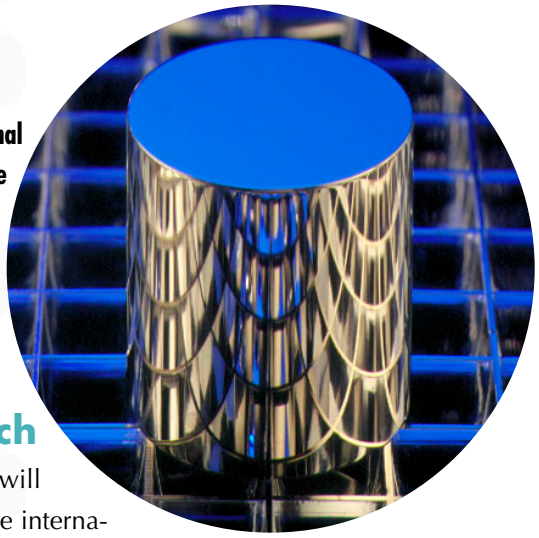
Program Funding:	$2.3 M
FTEs:	9.3

Program Goal

Develop and deliver timely measurements and standards to address identified critical U.S. industry needs for traceable mechanical metrology in the areas of acoustics, force, mass, and vibration, particularly for the support of trade and innovation, process-control, and quality in manufacturing.

Problem

The Mechanical Metrology Program maintains, realizes, and disseminate the SI units of sound pressure, force, mass, and acceleration to a broad customer base that covers numerous industries and impacts nearly every sector of the U.S. economy. The program staff must maintain and continuously enhance the high-quality, state-of-the-art measurement capabilities, and develop new research areas and measurement services to advance the state-of-the-art in mechanical metrology, provide new opportunities, and boost the competitiveness of the U.S. industry.



U.S. National Prototype Kilogram housed at NIST

Approach

The program will draw upon the internationally recognized skills and expertise of MEL staff in the mechanical metrology areas to develop new and improved measurement capabilities, provide high-quality measurement services, and guarantee open worldwide markets to U.S. industry by participation in international comparisons and standards committees. By increasing the emphasis on Research and Development (R&D), the program will respond to the customer needs for future measurement capabilities and increase the interactions with mechanical metrology R&D organizations and the "end-users" of devices and artifacts calibrated by MEL measurement services.

Typical Customers and Collaborators

Aerospace industry, automotive industry, construction industry, nuclear power industry, pharmaceutical industry, instrument manufacturers, university research labs, state weights and measures labs, federal agencies (Departments of Agriculture, Commerce, Defense, Energy, Labor, Veterans Affairs, and Justice, and the Food and Drug Administration).

For more information see page 86

Nano-manufacturing

Program Manager:	Michael T. Postek
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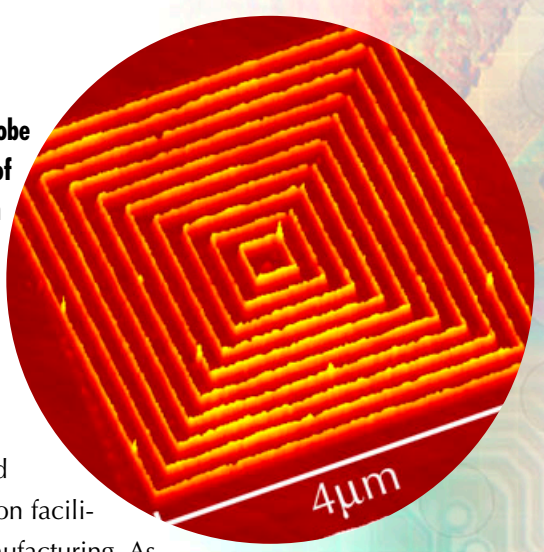
Program Funding:	$5.0 M
FTEs:	25

Program Goal

Develop and deliver timely measurements, standards, and infrastructural technologies that address identified critical U.S. industry and other government agency needs for innovation and traceable metrology, process-control and quality in manufacturing at the nanoscale.

Problem

Advanced nanomanufacturing is key to the strength and future growth of the U.S. manufacturing sector and a strong measurements and standards infrastructure is vital for its success. It has been predicted that within the next 10 years, at least half of the newly designed advanced materials and manufacturing processes will be built at the nanoscale. Measurement science (metrology) and advanced instrumentation are essential for nanomanufacturing. Metrology is a key enabler for all manufacturing. If you cannot measure it, you cannot make it and that statement is even more accurate in the regime of nanotechnology. Successful metrology infrastructure is essential for manufacturers to achieve the real promise of developing and manufacturing new nanomaterials, devices, and products. Advanced instrumentation provides the necessary data upon which sound scientific conclusions can be based and correct metrology provides the ability to interpret those data properly and accurately. Together, a successful metrology infrastructure and advanced instrumentation facilitate nanomanufacturing. As pointed out in the National Nanotechnology Initiative (NNI) Instrumentation Grand Challenge workshop final report, some of these metrology techniques will be evolutionary and some will be revolutionary. With that in mind, it is imperative that this program remain agile and evolve with the nanomanufacturing industry and adapt as new applications develop.



Scanned probe oxidation of hydrogen terminated silicon

Approach

The main theme of this research is "Developing the Nanometrology Infrastructure for Nanomanufacturing." The three fundamental thrust areas are: 1) Imaging and Metrology, 2) Nano-Fabrication, and 3) Control and Assembly Each of these areas addresses unique aspects regarding nanometrology infrastructure. The unique integration of these thrust areas into this program facilitate knowledge exchange to maximize the outcomes of the program.

Typical Customers and Collaborators

- University of Maryland
- Advanced Micro Devices
- Soluris
- International SEMATECH
- Hitachi High Technologies
- FEI Company
- E. Fjeld Company
- NASA
- Spectel Research
- INTEL
- IKLA Tencor
- Semiconductor Research Corp.
- Photronics and Dupont Photomask
- Nova Metrology tools
- Zyvex Corporation

For more information see page 98

Smart Machining Systems

Program Manager:	M. Alkan Donmez
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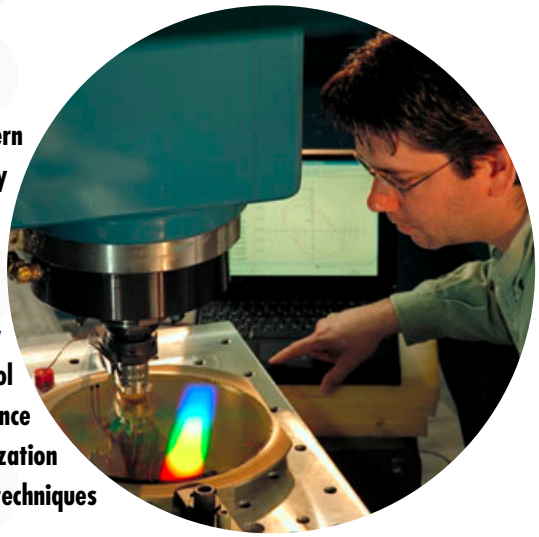
Program Funding:	$2.8 M
FTEs:	9

Program Goal

Develop metrology methods and standards that enable U.S. industry to characterize, monitor, and improve the accuracy, reliability and productivity of machining operations, leading to the realization of autonomous smart machining systems.

Problem

Coalition on Manufacturing Technology Infrastructure (CTMI) identified an urgent need for "enabling dramatic improvements in the productivity and cost of designing,planning, producing, and delivering high-quality products within short cycle times." CTMI identified thrust areas in process definition and design, smart equipment/process control, fundamental understanding of process and equipment, health monitoring/assurance and integration framework. It also stated that metrology and standards are key enablers of these thrust areas. This program aims to facilitate the development and validation of such measurement methods and standards. A successful program will enable the smart machining systems to cost effective manufacture the first and every part to specification and on schedule.



Modern metrology instruments allow development of new machine tool performance characterization techniques

Approach

The program focuses on developing a methodology for seamlessly integrating all science-based understanding or representation of material removal processes and machining system performance to carry out dynamic and global optimization. There are three programmatic focus areas: (1) performance characterization and representation; (2) process optimization and control; and (3) condition monitoring.

Typical Customers and Collaborators

Boeing, Caterpillar, Pratt& Whitney, Cincinnati Lamb, Hardinge Brothers, Bosch-Rexroth, Ford, Northrop Grumman, Optodyne, Roy-G-Biv, Third Wave Systems, VulcanCraft, American Petroleum Institute, Lion Precision, Heidenhain, Renishaw, Gibbs Associates, IQL, Association for Manufacturing Technology (AMT), The Integrated Manufacturing Technology Initiative (IMTI), U.S. Army, National Nuclear Security Administration (NNSA), National Aeronautics and Space Administration (NASA), University of Massachusetts, University of North Carolina Charlotte, University of Auckland, University of Aachen, University of Maryland.

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